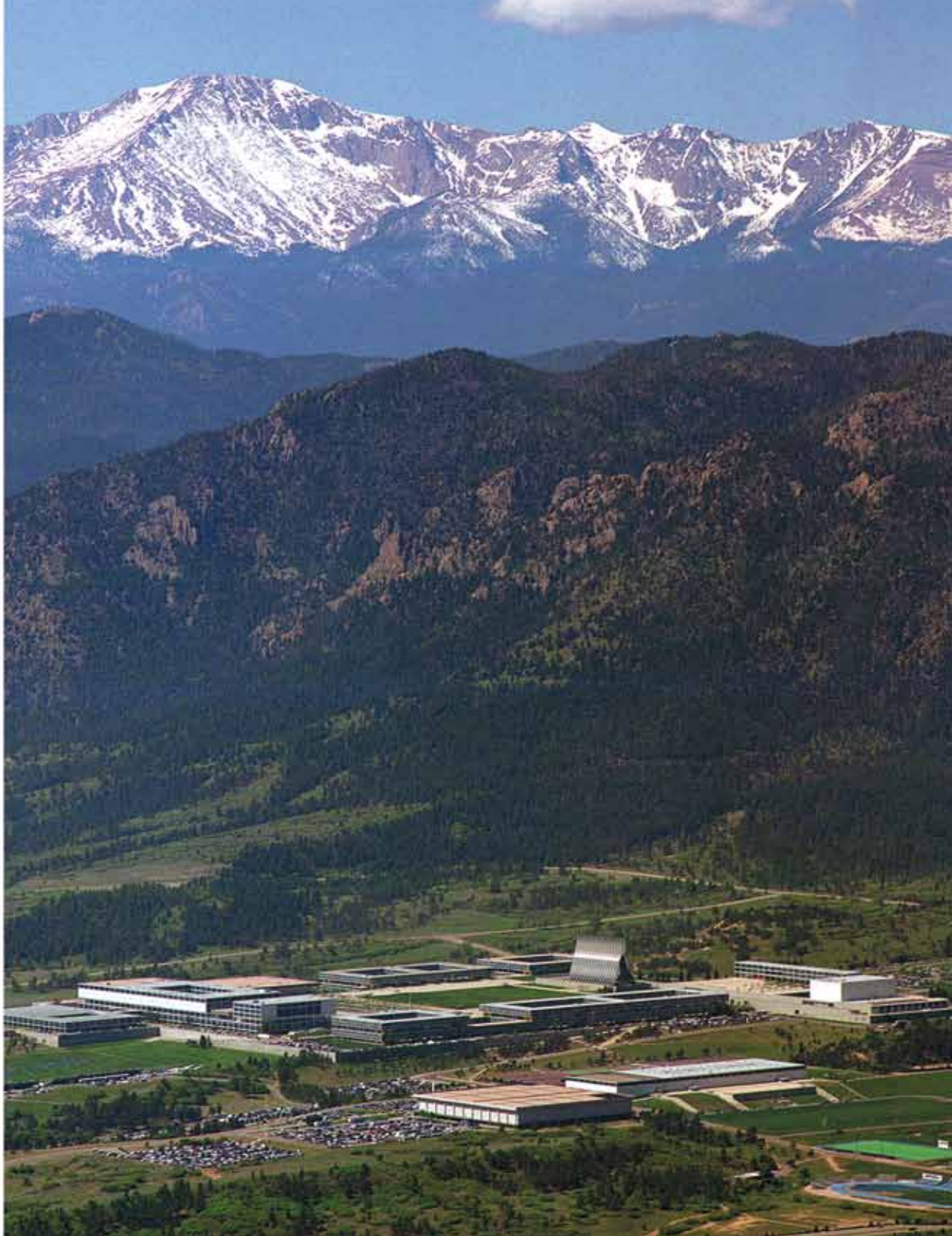
2009 United States Air Force Academy

Energy Strategic Plan

To A Net Zero Installation



Prepared By

The 10th Air Base Wing

and USAFA Dean of Faculty

Headquarters USAF Acacemy, CO

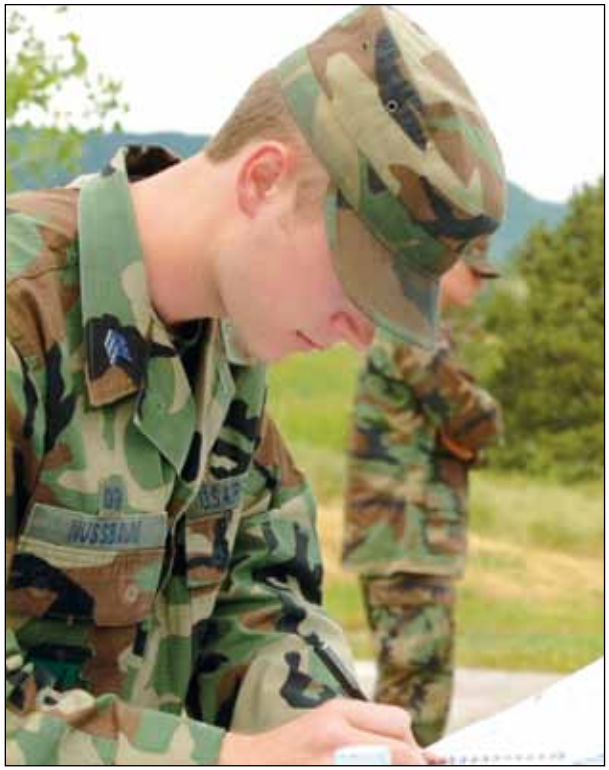
March 2009

INTEGRITY FIRST
SERVICE BEFORE SELF
EXCELLENCE IN ALL WE DO

TABLE OF CONTENTS

AIR FORCE ACADEMY ENERGY VISION

The United States Air Force Academy (USAFA) is committed to commissioning leaders of character who are devoted to societal, professional and individual responsibilities, including ethical reasoning and action, service to nation, and lifelong contributions. Our graduates are empowered by critical thinking, discipline and teamwork, grounded in the scientific method.



Energy awareness naturally flows as an essential part of learning-centered cadet education at the Academy, on a par with cultural immersion. The future leaders of the Air Force must learn to appreciate all aspects of energy production and consumption by the Air Force and the mission impact.

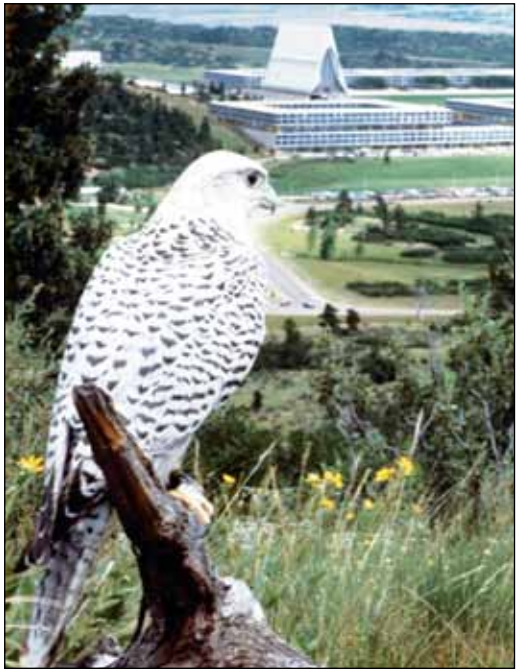
The 2008 United States Air Force Academy Energy Strategic Plan details a vision to improve our stewardship of fiscal and natural resources, by becoming a leader in the world of renewable energy and involving the 8,200 cadets, faculty and employees of USAFA. The vision is to be a "Net-Zero" electricity installation by 2015 and a carbon-neutral installation by 2025. These challenging and lofty goals raise the bar for the Department of the Air Force, the Department of Defense and the nation.

The symbiotic relationship at the Academy between education, research and implementation create an outstanding and unique platform from which to build a model for the future.

INTRODUCTION

The case for swift action to reduce our energy consumption and diversify our energy sources is more compelling than ever. Military forces will always be dependent on energy, but we must dramatically reduce the risk to national security associated with our current energy posture. Energy prices fluctuate tremendously and the cost of crude oil reaching nearly $150 per barrel in 2008 and expected to exceed that mark in future years. Major oil reserves are in countries or regions with governments or regimes that are at times unfriendly to U.S. and other western interests. Our fragile energy infrastructure, such as the national electrical grid and the country's crude oil refining capacity, may hinder our ability to reliably deliver energy during times of crisis.

These circumstances have awakened our nation — requiring a call for action that America is answering. Congress, the President and local government have established mandates in law and Executive Orders. Emerging technology and growing markets in renewable energy are diversifying our supply. This strategic plan established the platform for the Air Force Academy not only to answer, but play a leading role in our nation's call for action.



The Air Force Academy has the daunting mission to educate, train, and inspire men and women to become officers of character motivated to lead the United States Air Force in service to our Nation. We have an obligation to provide each future officer with a foundation that includes energy as a consideration throughout their Air Force career and beyond. While the energy used here at the Academy is only a small fraction of the overall Air Force consumption, the culture change we instill in future officers has the potential to change the energy landscape of the entire Air Force, if not our nation.

The Air Force Academy is positioned to lead the charge in energy conservation, conversion away from fossil fuels, and research into new, innovative renewable energy technologies. We have 18,500 acres of natural resources including forests, water, solar, wind, geothermal, kinetics and biomass. Our team includes committed leadership, talented research scientists and engineers, dedicated energy management professionals and a base populace that understands the importance of energy independence.

This plan delves into the Air Force Academy's goal to be a "Net-Zero" electricity installation and to reduce our carbon footprint from facility and transportation sources. Our broad objectives are challenging, yet achievable:

- Become a "Net-Zero" electricity installation by the end of calendar year 2015
- Meet all federal energy reduction mandates,
- Play a leading role in renewable energy research,
- Embody each cadet with an understanding that energy must be a consideration in all we do.

HISTORIC CONSUMPTION AND COST

USAFA builds on a history of past success, having made significant strides towards every federal mandate related to facility energy over the past 33 years. Recent mandates, requiring a 30 percent reduction by 2015, will be more difficult to achieve, forcing us to become far more aggressive. When new mandates are considered with previous mandates, our facility energy intensity will have reduced 60 percent from 1975 to 2015.

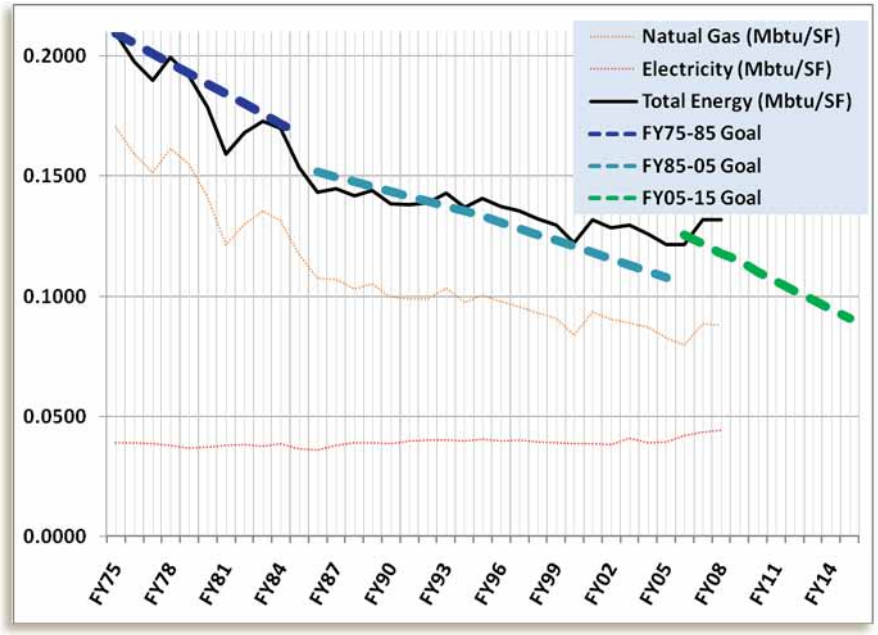


Figure 1. Historical Energy Reduction

Figure 1 shows our overall historical reduction of energy intensity (consumption per square foot) compared with mandated goals.

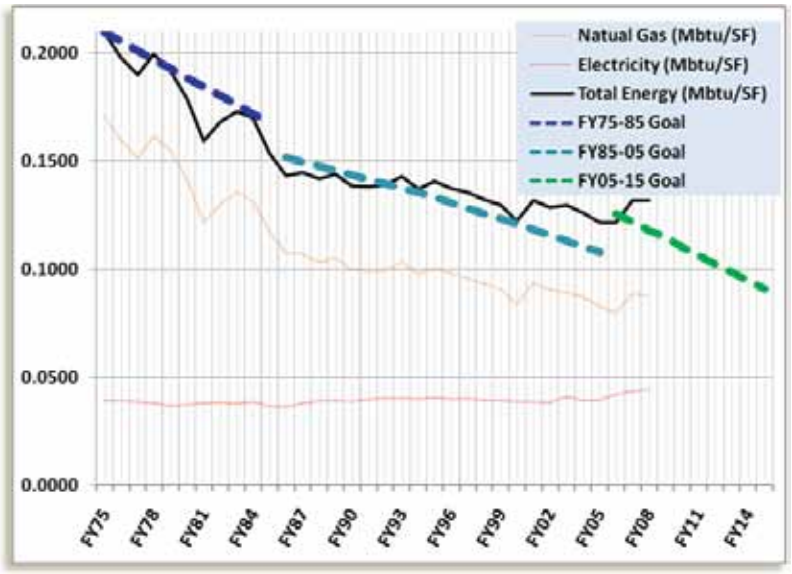
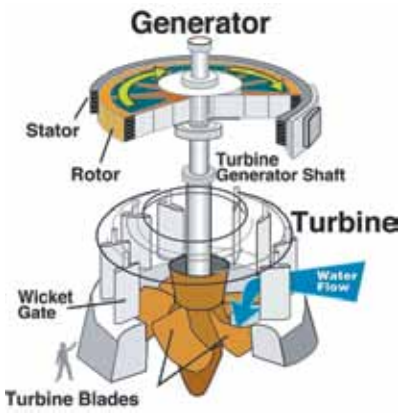


Figure 2. Historical Energy Costs

Although USAFA has made great strides in reducing our energy intensity, the cost of utilities has trended steadily upward from $2M in FY75 to $12M in FY08. Figure 2 illustrates the increase. It is estimated with the energy reduction measures since 1975, USAFA has saved $35M in present-day dollars.



Utility Costs and Escalation

Through calendar year 2015, we have a site picture on utility rate increases and they extend far beyond anticipated inflation. Table 1 indicates our 2008 utility rates from our provider Colorado Springs Utilities (CSU). Table 2 shows CSU's forecasted rate increases from 2009 to 2015. The escalation is anticipated to continue into 2016 and beyond.

Utility Rate Comparison

	Colorado Springs Utilities	Western Area Power Administration	Intermountain Electric	Mountain View Electric
Electric	$0.052	$0.032	$0.059	$0.096
Natural Gas		Not Applicable	Not Applicable	Not Applicable
Firm	$7.092	Not Applicable	Not Applicable	Not Applicable
Interruptible	$5.620	Not Applicable	Not Applicable	Not Applicable
Water	$1.932	Not Applicable	Not Applicable	Not Applicable
Wastewater	Not Applicable	Not Applicable	Not Applicable	Not Applicable

Table 1. 2008 Utility Rates

Colorado Springs Utilities Forecasted Rate Changes as of Oct 2008
Based upon percent increase from previous years' rate

	2008	2009		2010		2011		2012		2013		2014		2015	
	Current Rate $	Projected Increase		Projected Increase		Projected Increase		Projected Increase		Projected Increase		Projected Increase		Projected Increase	
		%	Rate	%	Rate	%	Rate	%	Rate	%	Rate	%	Rate	%	Rate
Electric	$0.052	22.00%	$0.064	16.61%	$0.075	6.30%	$0.079	-0.13%	$0.079	5.57%	$0.084	-5.75%	$0.079	3.70%	$0.082
Natural Gas															
Firm	$7.092	14.96%	$8.153	10.35%	$8.996	2.18%	$9.193	1.27%	$9.309	0.21%	$9.329	0.67%	$9.391	1.50%	$9.532
Interruptible	$5.620	14.96%	$6.461	10.35%	$7.130	2.18%	$7.285	1.27%	$7.378	0.21%	$7.393	0.67%	$7.443	1.50%	$7.554
Water	$1.932	33.71%	$2.583	38.14%	$3.569	16.97%	$4.174	16.99%	$4.883	5.78%	$5.166	0.00%	$5.166	0.00%	$5.166
Wastewater	N/A	13.43%	N/A	10.80%	N/A	8.89%	N/A	4.82%	N/A	0.00%	N/A	0.00%	N/A	0.00%	N/A

Table 2. Colorado Springs Utilities Forecasted Rate Changes

Figure 3 shows the projected utility budget (at the current consumption rate including escalations shown in Table 2), totaling nearly $20M by 2015 (present-day dollars).

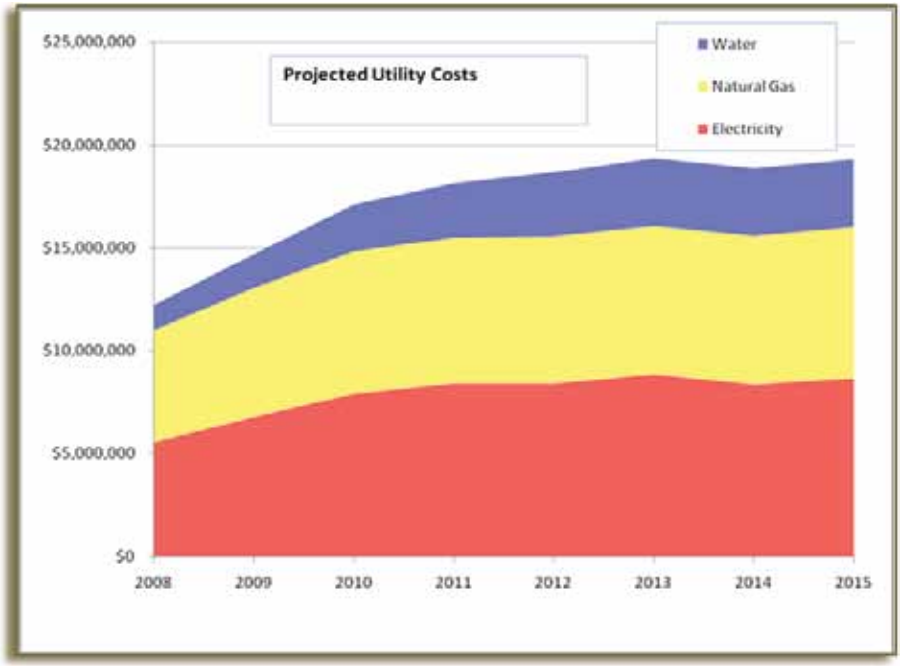


Figure 3. Project Utility Cost Increase (2008-2015)

Transportation Fuels

The USAFA fleet of 300 vehicles consumes approximately 275,000 gallons of diesel and gasoline at a cost of $875,000 annually. Opportunities exist to substantially reduce petroleum-based transportation fuel consumption by

- improving fuel efficiency (better matching vehicle characteristics to mission needs)
- converting waste cooking oil from Mitchell Hall to biofuels,
- expanding use of the existing compressed natural gas (CNG) infrastructure, and
- evaluating electric-powered vehicles.

Potential annual savings could be as high as $260,000 with current fuel prices.

Economic Pressure

The pressure of increasing utility rates and demand for funding, all while maintaining a high level of excellence in our education and training mission, will make further conservation of energy and on-site renewable generation an absolute necessity. Our challenge is to use the available funding wisely to support initiatives that both improve energy efficiency and reduce consumption.

Energy Security

"… a tendency in our planning to confuse the unfamiliar with the improbable. The contingency we have not considered looks strange; what looks strange is therefore improbable; what seems improbable need not be considered seriously."

— Thomas C. Schelling, Foreword to Roberta Wohlstetter, *Pearl Harbor: Warning and Decision* (1962)

The instability in fossil-fuel generated power due to the global nature of the commodities involved is evident each day. Whether energy shortages or fluctuations are due to malevolent causes (terrorist attacks) or malignant causes (grid over utilization, natural occurrences) the mission of the Air Force Academy must continue.

RENEWABLE ENERGY OPPORTUNITIES

The Air Force Academy is excited to enter into on-site renewable energy generation. It provides energy security, hedges our utility costs and provides a great opportunity for Dean of the Faculty staff and cadet interaction and learning. 12 MW of on-site renewable generation at peak load (approximately 108,000 MWh) is the target. Through a multitude of renewable and green sources including hydro-electric, solar, wind, biomass, and waste-to-energy we will achieve electrical energy independence from fossil-fuel based power generation.

- What we are exploring:
- Electric Power Generation (Target 12 MW)
  - Dry Fermentation Biomass – USAFA Initiative ($ TBD)
    - 2 MW fermentation of waste to create power – not sited
  - Solar power – USAFA/Utility Joint Initiative ($40.0M)
    - 2 MW solar array generation site
    - 2 MW solar array not currently sited
  - Hydro power – USAFA/CSU Joint Use ($3.1M)
    - 1.37 MW possibility from location near USAFA
  - Waste-to-Energy – USAFA Initiative ($TBD)
    - 1 MW sludge and oil waste to energy
  - Wind Power ($TBD)
  - 4 MW being evaluated – not sited

- Other initiatives
  - Geothermal Heat Pumps – USAFA Initiative ($2.5M)
  - Decentralization – USAFA Initiative ($4.5M)
  - Low profile wind – USAFA Initiative ($300K)
  - Woody Biomass – ESPC ($12M)
  - Cooking oil waste to biodiesel – Dept of Homeland Security ($30K)

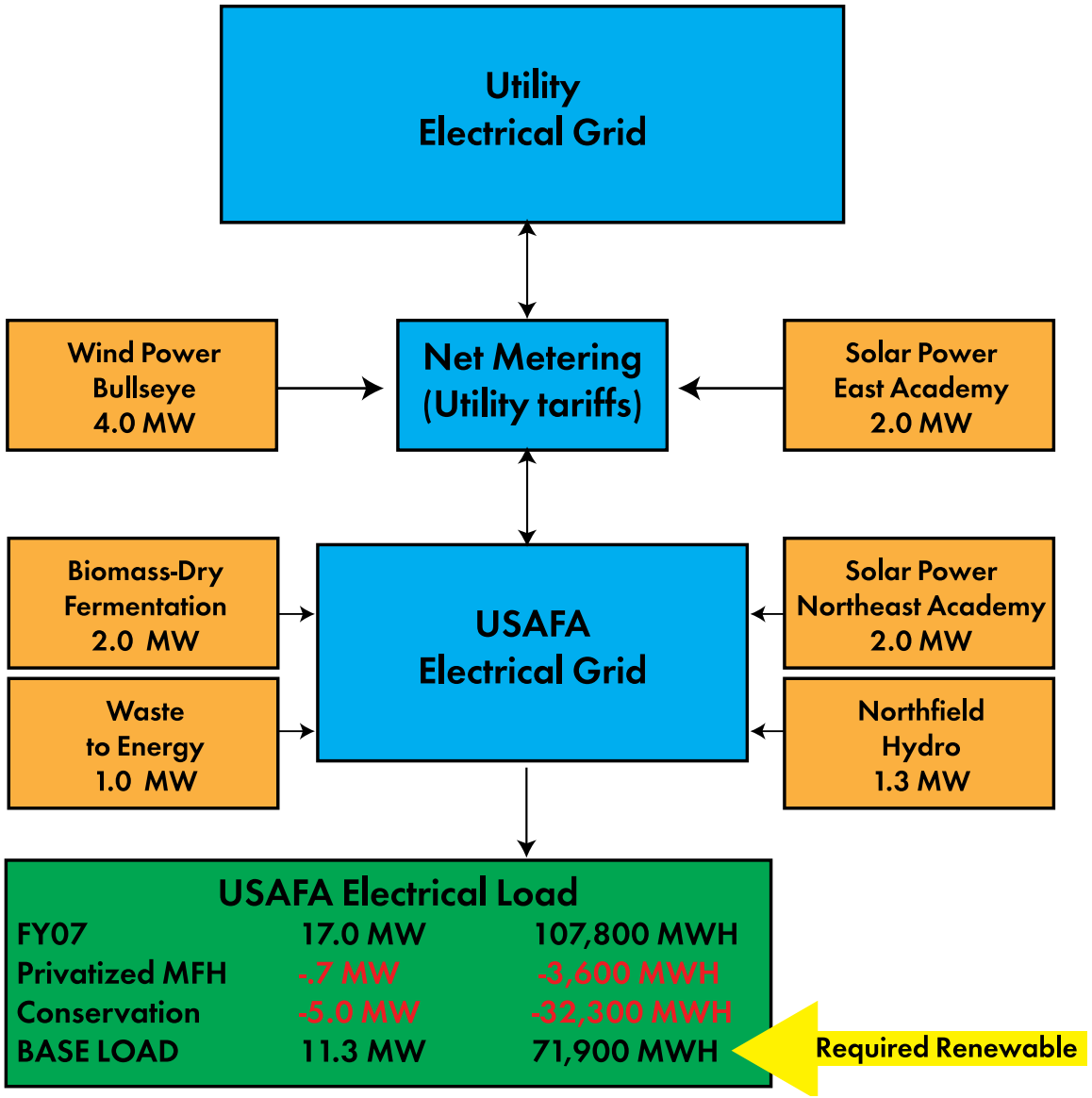


Figure 4. USAFA Electrical Requirement

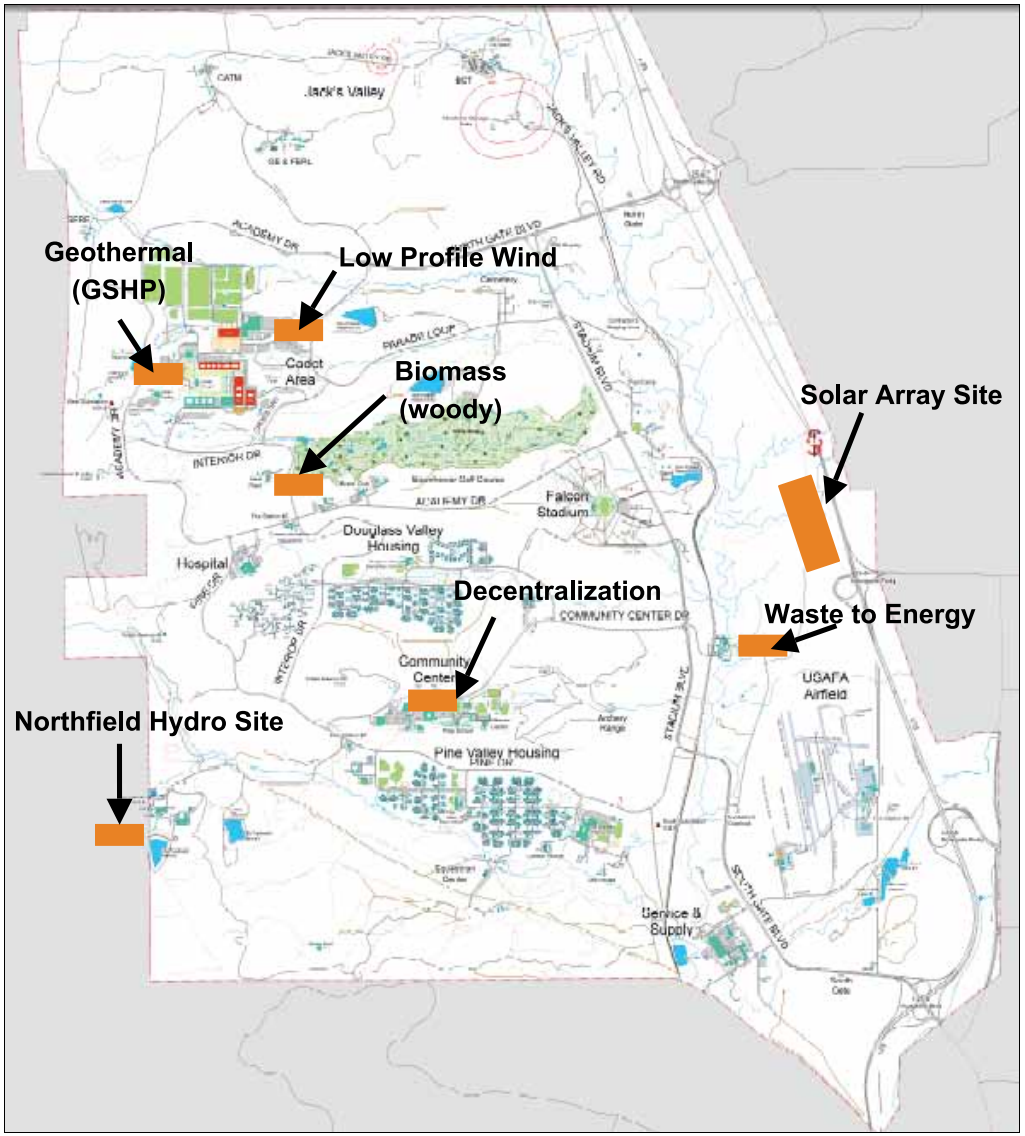
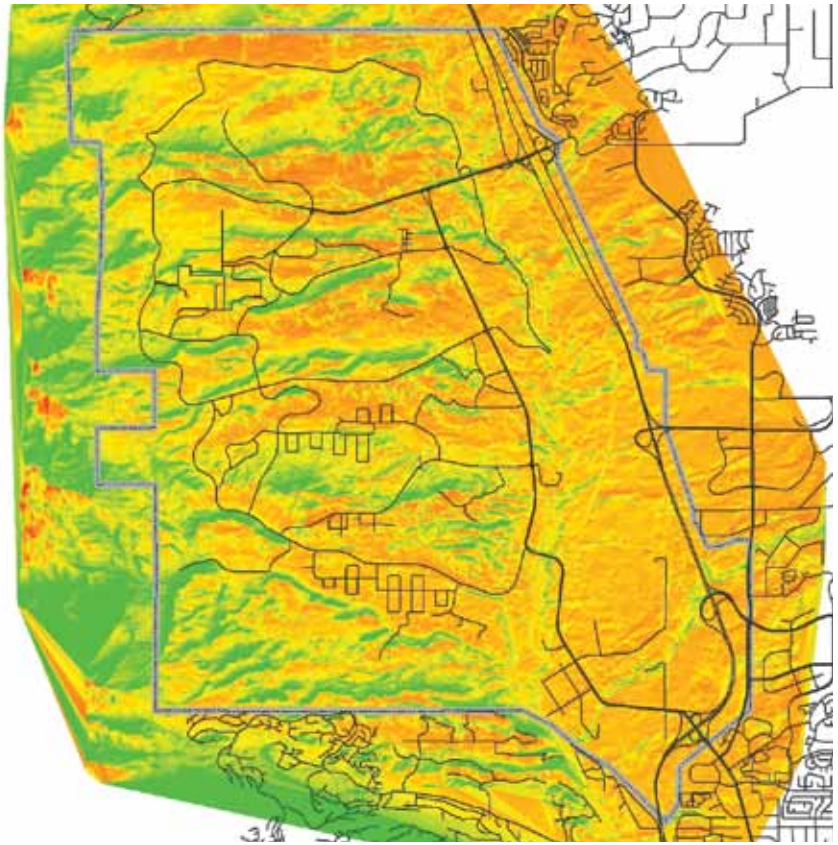


Figure 5. Potential Renewable Sites

USAFA is comprised of 18,500 acres of natural resources; one of our nation's greatest treasures. While we aggressively pursue our goal of "Net-Zero," we must never forget to protect our natural resources. Aside from our people, natural resources are the greatest asset towards meeting our ultimate goal of a carbon-neutral footprint. Our efforts must align with existing best management practices developed to maintain biological diversity and ecosystem function within the Air Force Academy. This philosophy combined with our obligation to be respectful of neighboring communities and their needs has driven the preliminary renewable project sites shown in Figure 6.



Many avenues are being considered for funding of such a bold endeavor. We estimate an initial investment of approximately $100 million between 2009 and 2015 to implement the renewable projects. Appropriated funding through the MILCON process will be considered along with donor funding, power purchase agreements and other public/private partnerships. Figure 6 illustrates our projected return on investment based on the initial capital investment and projected energy costs for the next nearly 20 years.

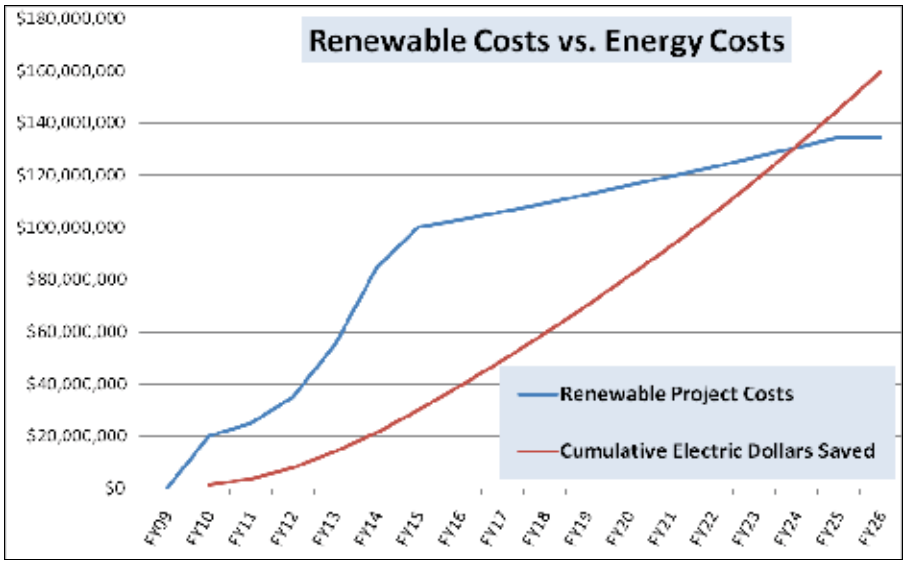


Figure 6. Projected Return on Investment

CONSERVATION

Since President Jimmy Carter declared "the moral equivalent of war on the energy crisis," the United States has adopted the "reduce, reduce, reduce" solution. Some improvements have been noticeable, for example, in higher-efficiency heating and cooling devices and more efficient automobile engines. Unfortunately, these gains have largely been offset by an American "bigger is better" trend (larger automobiles, larger engines, larger homes, longer commutes, etc.) Conservation is part of the solution; however, it is neither a complete solution nor an infinite resource.

While much of the Net-Zero initiative involves building a renewable energy supply, approximately one-third of the total savings is slated to come from conservation, shifts in usage pattern, more energy-efficient infrastructure, etc. Any serious conservation effort must look at our facilities support contracts as well to ensure we are incentivizing the contractors to save energy.

A concerted effort to improve the efficiency of (government-owned) base vehicles should set high goals. When replacement vehicles are purchased, smaller, more efficient vehicles must be considered. Leadership must set the example because of their high visibility.

FACILITY INFRASTRUCTURE

The 6.4 million square feet of facilities at the Air Force Academy are ground zero for conservation and renewable implementation. Improvement of infrastructure in our current facilities, vehicles and equipment through specific actions such as improving building envelope thermal resistance; installing energy efficient lighting, heating, air conditioning and ventilation equipment; re-commissioning (tuning up) building systems; maximizing space utilization; rightsizing the vehicle fleet; and replacing inefficient system components with high efficiency ones is key. The "Fix USAFA" initiative targets many of our major and aged facilities. The initiative brings advances from the last 50 years into the facilities. Energy and sustainability are the foundation of the renovations. Figure 7 below provides an overview of the "Fix USAFA" program.

PRI	TITLE (# of Phases)	Year Built	06	07	08	09	10	11	12	13	14	15
	FUNDING SECURED ($M)		21	37.5	65.4	40	50	50	50	50	50	50
1	Fairchild Hall (7)	1958										
2	Mitchell Hall (6)	1959										
3	Cadet Gym (7)	1960										
	Cadet Gym Addition											
4	Vandenberg Hall (9)	1958										
5	High Temp Hot Water (7)	Multi										
6	Field House	1968										
7	Arnold Hall (2)	1958										
8	Roads & Parking	Multi										
9	Airfield Pavements	Multi										
10	Dams & Bridges	Multi										
11	Water Systems	Multi										
12	CETF	1996										
13	Chapel Roof (5)	1963										
14	Non-Water Infrastructure	Multi										
15	Support Buildings	Multi										
	Program Development											

Figure 7. Fix USAFA

RESEARCH

The improvements integral to the Fix USAFA initiative are:

- High efficiency mechanical, electrical and HVAC equipment,
- Security and energy efficiency upgrades to the window wall systems,
- Improved insulation,
- Utilization of natural lighting,
- Energy focused roofing replacements,

The Air Force Academy's goal exceeds that of the Air Force with our minimum requirement being a LEED Gold certifiable facility: LEED Existing Building (EB) for a renovation project; or LEED New Construction (NC) for the MILCON program.

The Air Force Academy with a great history in academics, athletics and leadership also has the distinction of having a National Historic Landmark District within its boundaries. The Cadet Area, a symbol of the international style architecture, is paramount to the mission of the Academy. Within this context the future construction has high architectural standards it must meet as well as stringent energy and conservation standards.

In the next 8 years, the Academy will spread its wings, evolve and grow through the Military Construction (MILCON) program. This program targets academics (Fairchild Hall), athletics (Cadet Fitness Center), our core mission, educating leaders of character (Center for Character & Leadership Development) and research (Fast Tracking Telescope, Aero Lab Trans-sonic Wind Tunnel, etc).

FY	MILCON PROJECT
09	Fairchild Hall Phase V
10	Cadet Fitness Center
11	Center for Character & Leadership Development
12	Large Vehicle Search Facility
13	Fast Tracking Telescope
14	Aero Lab Wind Tunnel Addition
15	Enlisted Dormitory

TRANSPORTATION

The USAFA fleet of 300 vehicles consumes approximately 275,000 gallons of diesel and gasoline at a cost of $875,000 annually. Air Force policies mandate a 2% reduction in fossil fuel usage per annum. Opportunities exist to substantially reduce petroleum-based transportation fuel consumption by improving fuel efficiency, producing biofuels from waste oils, expanding use of compressed natural gas, and evaluating electric-powered vehicles.

USAFA's 2015 transportation fuel plan includes four key components:

- First, analyze mission needs and match new vehicle purchases with requirements. For example, large SUVs, currently gasoline-powered 4WD Chevrolet Tahoes, in some cases can be replaced with gasoline-powered 4WD Ford Escapes, saving 40% on fuel consumption. Analysis also shows the opportunity to convert 90 vehicles in the fleet to hybrid, low speed vehicles by 2015 at a reasonable cost.
- Second, replace 20,000 gallons of conventional diesel with bio-diesel produced from waste food oil at Mitchell Hall, reducing conventional diesel usage by 8%. The bio-diesel hardware has already been funded by the Dept. of Homeland Security and was installed in the department of Chemistry in March 2009. Dispensing a 90/10 diesel/bio-diesel blend will require construction of storage and pumping facilities. Project XQPZ06-3001 is planned for fiscal year 2013.

- Third, investigate expanded use of compressed natural gas (CNG) in non-diesel vehicles take advantage of the CNG fueling plant on the Academy.
- Fourth, consider deploying 10 electric-powered buses. Fuel cell buses are currently being tested at Hickam AFB, HI. Fully outfitted, these vehicles are estimated to cost approximately $1 million each. Current technology indicates these buses will initially be used for intra-base shuttle service, which could support our airmanship and major events at USAFA. Recharging would be via renewable electric energy generated on the Academy.

Methods to reduce non-government transportation fuel consumption (primarily daily commuter vehicles) are yet to be worked out, but could included shuttle bus service from the North and South Gates, incentives for car-pooling and ride-sharing, guaranteed ride home programs, etc.

Research into bio-derived aviation fuels is not yet mature enough to make projections of possible savings.

RESEARCH

The concept of establishing an Academy Center for Renewable Energy has been discussed in various forms for the past seven years, but has taken on new impetus with $147/bbl oil and several Executive Orders related to energy in 2008.

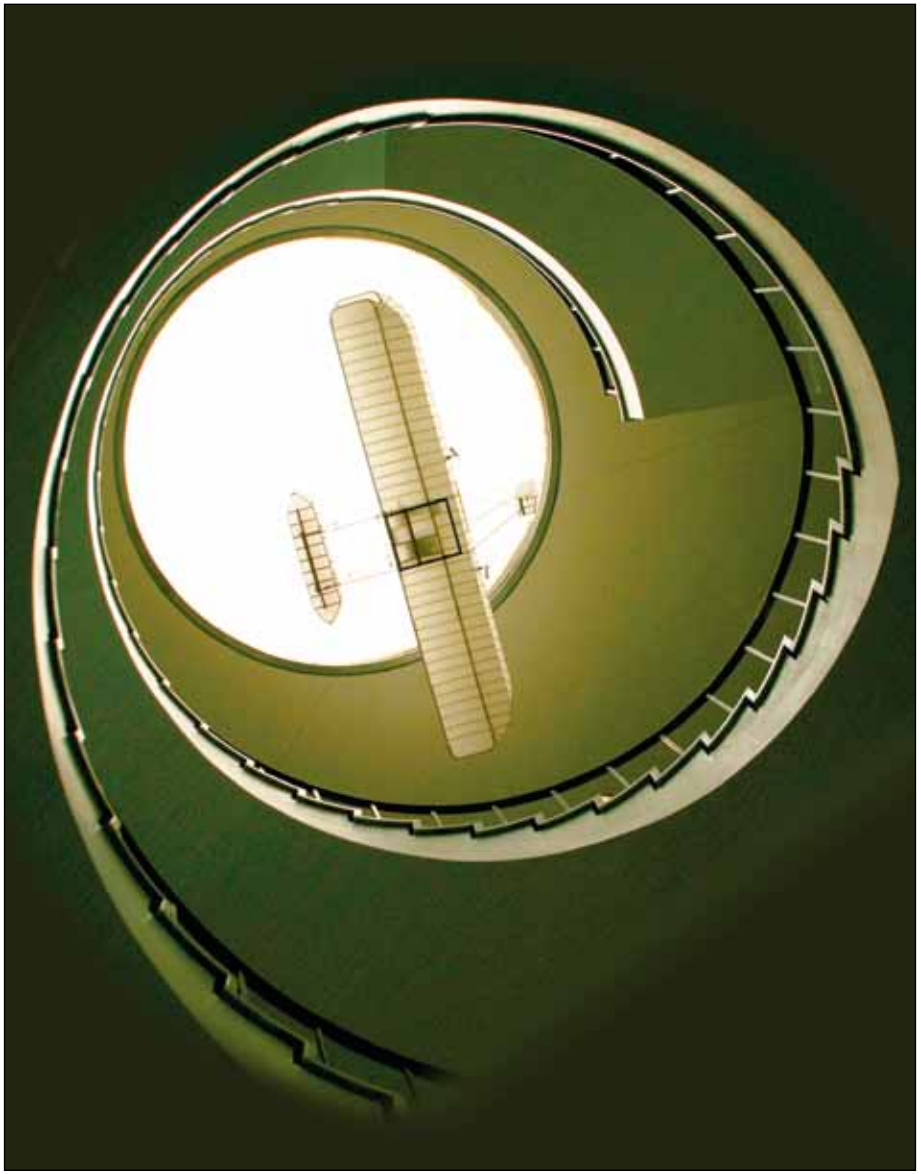
The research vision and strategy involves cadets in each and every project. Faculty energy research includes a number of existing and planned projects. As is appropriate, most efforts are focused on long-term basic and applied research, with payoffs past five to ten years. Some may have applications on near-term renewable energy options. Examples of ongoing faculty and cadet research include:

- Chemistry (hydrogen storage, advanced lithium batteries, molten salts for thermal storage),
- Physics (optics for improving photovoltaic efficiency),
- Biology (biofuels from algae),
- Aeronautics (wave and wind power, turbines, heat transfer).

These longer-term initiatives will be bolstered as more cadet and faculty energy research will begin this summer with the Air Force Research Laboratory, Installations Branch (AFRL/RXQ) and the National Renewable Energy Laboratory (NREL). In addition to looking far into the future, a multi-disciplinary Academy Center for Renewable Energy would provide valuable knowledge and science-based recommendations, allowing the Energy Management Steering Group to pursue only technically viable, proven, economically feasible options for a shorter-term, alternative-fuel-based Net Zero infrastructure.

CONCLUSION

The Air Force Academy embraces the energy challenges of today and tomorrow with our vision. Our Net-Zero goal is USAFA's answer to the nation's call for action. It is a lofty goal and will test our abilities. The renewable technologies we implement will enhance the facilities on USAFA as well as augment the education and research environment. Our conservation initiatives will evoke a culture change where the natural resources of the nation are not dwindled away but reused and recycled for a brighter future. When attained in 2015, we will have successfully minimized risk to USAFA from increasing utility costs for the foreseeable future, illustrated that energy independence is possible, exhibited good stewardship of non-renewable resources and set the benchmark for the department of defense and our nation.




10TH AIR BASE WING


DEAN OF THE FACULTY